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NGV Codes, Standards and Safety

Report on Activities
January 2002 to September 2003

Prepared for:

Transportation Development Centre

of

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by

Charonic Canada Inc.

May 2004

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Nick White

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16. Abstract

This report summarizes activities in the final phase of a long-term joint government-industry campaign to develop and publish natural gas vehicle codes and standards and to address safety incidents.

Under contract to Transport Canada's Transportation Development Centre, Charonic Canada Inc. and Powertech Labs Inc. provided technical support regarding safety, standards and codes that are relevant to the federal government and Canadian gas distribution companies with a natural gas vehicle program in their franchise area. Charonic Canada Inc. also supplied secretariat support for the Natural Gas Vehicle Research and Development Committee.

The report outlines the standards development process and lists the major meetings of committees, working groups and regulatory agencies attended during the reporting period. It also indicates the status of the various codes and standards documents.

The work is intended to help ensure that Canadian codes and standards reach a mature stage, providing a high level of safety to both the public and industry, while allowing the introduction of new technologies. It is directly applicable to the development of codes and standards for other gaseous vehicle fuels, such as hydrogen. Ongoing maintenance of natural gas standards will be required to reflect new technical advances and address any emerging safety issues.

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16. Résumé

Le présent rapport résume les activités qui ont marqué la dernière phase d'une campagne de longue durée menée conjointement par le gouvernement et le secteur privé en vue d'élaborer et publier des codes et normes sur les véhicules au gaz naturel, et d'étudier les incidents de sécurité reliés à ces véhicules.

Aux termes d'un marché conclu avec le Centre de développement des transports de Transports Canada, Charonic Canada Inc. et Powertech Labs Inc. ont fourni un soutien technique concernant les questions de sécurité, les normes et les codes pouvant intéresser le gouvernement fédéral et les entreprises canadiennes de distribution de gaz desservant des régions où il existe des programmes de véhicules au gaz naturel. Charonic Canada Inc. a également fourni des services de secrétariat au Comité de recherche et développement sur les véhicules au gaz naturel.

Le rapport décrit le processus d'élaboration des normes et dresse la liste des principales réunions de comités, groupes de travail et organismes de réglementation tenues pendant la période visée par le rapport. Il précise également l'état d'avancement des divers projets de codes et de normes.

Ces travaux visent à amener les codes et normes canadiens à un stade de maturité tel qu'ils garantissent un niveau élevé de sécurité au public et à l'industrie, et qu'ils permettent l'adoption de nouvelles technologies. Ces travaux sont directement applicables à l'élaboration de codes et de normes relatifs à d'autres carburants gazeux pour véhicules, comme l'hydrogène. Il faudra, dans l'avenir, procéder à des mises à jour constantes des normes touchant le gaz naturel, afin d'y incorporer tout progrès technique et toute préoccupation émergeante en matière de sécurité.

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Executive Summary

With the support of Natural Resources Canada and Transport Canada's Transportation Development Centre, the natural gas vehicle industry has been funding the development of codes and standards since the introduction of natural gas vehicles (NGVs) in Canada in the mid-1980s. This work has involved the production of codes and standards documents as well as considerable research and development work. The latter has encompassed materials, components and assemblies used in the production of advanced fuel vehicles as well as the development of test procedures by which these materials, components and assemblies may be evaluated.

Manufacturers have increasingly taken over the codes and standards development work from the gas industry consortia that originally sponsored it. Deregulation of the gas industry has also brought about significant changes in the role of the gas utilities. NGV has moved into the deregulated part of the industry, and the gas utilities are focussing on their traditional natural gas safety roles as the codes, standards and safety work enter a maintenance mode now that the NGV industry has become established.

Although the development of NGV standards has reached a mature stage, there are issues that will need to be addressed in the future. Maintenance of standards is an issue as new technology is introduced. The component standard is outdated and does not reflect a number of new technologies. It will need a comprehensive review and expansion to include new technology and up-to-date test procedures.

This report concludes the long-term Canadian joint government-industry campaign to address safety incidents, and develop and publish NGV standards and codes. The value of the work that has been undertaken in Canada is evident, not only by the adoption of these documents by authorities in Canada and the low number of incidents, but also in two other areas.

First, the methodology and approach taken in the Canadian and joint Canadian/US documents has been adopted widely both in ISO and other countries. Second, the documents produced for natural gas are well suited for use with other gaseous fuels and have, in many cases, formed a starting point for work on hydrogen-fuelled vehicles.

Sommaire

Appuyée par Ressources naturelles Canada et le Centre de développement des transports de Transports Canada, l'industrie des véhicules au gaz naturel (VGN) finance l'élaboration de codes et de normes depuis que les VGN ont fait leur apparition au Canada, au milieu des années 1980. Ces travaux ont comporté non seulement la rédaction de projets de codes et de normes, mais aussi des projets de recherche et développement d'envergure. Dans cette deuxième catégorie, on compte des études sur les matériaux, composantes et assemblages utilisés dans la construction de véhicules mus par de nouveaux carburants, ainsi que l'élaboration de méthodes d'essai pour évaluer ces matériaux, composantes et assemblages.

Peu à peu, les constructeurs de véhicules ont repris à leur compte le travail d'élaboration de codes et de normes initialement parrainé par les acteurs de l'industrie gazière réunis en consortiums. De plus, la déréglementation de l'industrie gazière a modifié en profondeur le rôle des entreprises de distribution de gaz. Le VGN est passé dans le volet non réglementé de l'industrie, et les entreprises de distribution de gaz se concentrent sur leurs rôles traditionnels touchant la sûreté du gaz naturel. En même temps, le travail sur les codes, les normes et la sécurité entre en mode «mise à jour», maintenant que l'industrie des VGN est bien établie.

L'élaboration de normes relatives aux VGN est arrivée à maturité, certes, mais il ne faut pas penser que tout est définitivement réglé. Ainsi, le problème de la mise à jour des normes se posera chaque fois qu'une nouvelle technologie fera son apparition. La norme sur les composantes est déjà périmée, puisqu'elle passe sous silence un certain nombre d'innovations technologiques. Il faudra procéder à une refonte complète et à des ajouts pour y intégrer les nouvelles technologies et des procédures d'essai à jour.

Ce rapport marque la conclusion de la campagne de longue durée mise sur pied par le gouvernement et le secteur privé du Canada pour étudier les incidents de sécurité reliés aux VGN et élaborer et publier des normes et des codes sur les VGN. Les travaux réalisés au Canada ont une valeur incontestable, non seulement parce que les documents élaborés ont été adoptés par les autorités canadiennes et que le nombre d'incidents de sécurité est faible, mais pour deux autres raisons.

Premièrement, la méthodologie et la démarche adoptées dans les documents canadiens et les documents conjoints Canada/États-Unis ont été largement reprises par l'Organisation internationale de normalisation (ISO) et d'autres pays. Deuxièmement, les documents rédigés pour le gaz naturel sont faciles à transposer à d'autres carburants gazeux et il ont souvent servi de point de départ pour l'élaboration de documents normatifs sur les véhicules mus à l'hydrogène.

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Glossary of Acronyms

AGA	American Gas Association
ANSI	American National Standards Institute
CCi	Charonic Canada Inc.
CEC	Canadian Electrical Code
CGA	Compressed Gas Association
CNG	Compressed natural gas
CSA	Canadian Standards Association
US DoE	United States Department of Energy
GRI Canada	Gas Research Institute Canada
IANGV	International Association for Natural Gas Vehicles
IAS	International Approval Services
ISO	International Organization for Standardization
MDIP	Market Development Incentives Program
NFPA	National Fire Protection Association (US)
NGV	Natural gas vehicle
NGV R&D Committee	Natural Gas Vehicle Research and Development Committee [of Natural Resources Canada]
NGVC	Natural Gas Vehicle Coalition (US)
NGVTF	Natural Gas Vehicle Technology Forum [of the US Department of Energy]
NRCan	Natural Resources Canada
OEM	Original equipment manufacturer
PRD	Pressure relief device
PLI	Powertech Labs Inc.
SCC	Standards Council of Canada
TDC	Transportation Development Centre [of Transport Canada]
TSSA	Technical Safety Standards Authority (Ontario)
VRA	Vehicle refuelling appliance

1. Introduction

Canadian federal and provincial governments have a long history of working with the advanced fuels industry to allow manufacturers to adopt new and improved technologies while at the same time ensuring that a high level of public safety is maintained. With the support of Natural Resources Canada (NRCan) and Transport Canada's Transportation Development Centre (TDC), the natural gas vehicle industry has been funding the development of codes and standards since the introduction of natural gas vehicles in Canada in the mid-1980s. This work has involved the production of codes and standards documents as well as considerable research and development work. The latter has encompassed materials, components and assemblies used in the production of advanced fuel vehicles as well as the development of test procedures by which these materials, components and assemblies may be evaluated.

The program for development of natural gas vehicle (NGV) codes and standards in Canada has been sponsored by the Canadian Gas Association (CGA), with contributions from the gas utilities, NRCan and TDC. The NGV Coalition and the Gas Research Institute sponsored NGV code development in the United States. Canadian expenditure on codes, standards and safety peaked in the early 1990s at approximately $1,000,000 a year. A similar sum was spent annually in the United States.

With the maturity of the NGV industry, the codes, standards and safety work entered a maintenance mode. Manufacturers have increasingly taken over the codes and standards development work from the gas industry consortia that originally sponsored it. Deregulation of the gas industry has also brought about significant changes in the role of the gas utilities. NGV has moved into the deregulated part of the industry, and the gas utilities are focussing on their traditional roles involving the maintenance of natural gas safety.

Canadian participation in international codes and standards has become more important in recent years. Prior to the adoption of the North American Free Trade Agreement in 1994, Canada and the United States maintained independent sets of codes and standards. Since that time, the gas industries in the two countries have sponsored a harmonization of Canadian and U.S. codes and standards. The Standards Council of Canada (SCC) and American National Standards Institute (ANSI) separately accredit the harmonized documents.

The entry of vehicle OEMs and the globalization of the vehicle market have resulted in greater significance of the International Organization for Standardization (ISO) process. It is anticipated that, over the next ten years, Canada will adopt most of the ISO documents now being developed. It is important to ensure that Canada's interests and concerns are represented during the development phase.

The safety, codes and standards work described in this report covers the period January 2002 to September 2003. This follows similar projects undertaken in previous years.

2. The Work and the Contractors

Charonic Canada Inc. (CCi) was contracted by TDC to address identified or perceived issues in the areas of safety, codes and standards that are relevant to natural gas vehicles and their associated technologies during the period January 2002 to September 2003. The work covered the following areas:

- represent Canadian issues and concerns during the development, precognition, implementation and revision of codes and standards related to natural gas vehicles and associated technologies;
- liaise with provincial and federal regulatory agencies with respect to adoption and interpretation of codes and standards;
- provide advice and assistance to manufacturers and users regarding safety, codes and standards;
- provide secretariat services to the NGV R&D Committee established to oversee the expenditure of funds transferred from GRI Canada to NRCan; and
- assist with troubleshooting and fast response to incidents and issues in the industry.

CCi performed the work on this project in conjunction with Powertech Labs Inc. (PLI). Because the activities cover a wide range of topics and the level of effort proposed for all the safety, codes and standards work was less than the fully allocated cost of one person, it was agreed that two experienced contractors should undertake the work on an "as needed" basis.

This approach worked successfully for the reporting period discussed herein as well as for the two previous years. It enabled the project to meet the overall industry needs with the required expertise while avoiding the cost of full time staff. The qualifications of the contractors are discussed below.

Charonic Canada Inc. (CCi)

Nick White, who founded Charonic Canada Inc. in 1998, has participated in much of the NGV standards development work throughout the 1990s and beyond. As the program administrator for the NGV Research and Development Fund from 1990 to 1998, he represented its members on the Canadian Standards Steering Committee and served as the Chair or member of a number of the Standards Committees and Working Groups.

Powertech Labs Inc. (PLI)

Powertech Labs Inc. has worked very closely with the NGV industry on high-pressure gas storage and containment issues. In addition to specific work commissioned to resolve identified issues, a team headed by Craig Webster was retained by the NGV Research and Development Fund on an annual consulting contract to help resolve issues as they arise.

3. The Standards Development Process

Much of the work in this project involved the development of codes and standards documents, revisions and addenda to existing codes and standards, and the recognition of new codes and standards by authorities having jurisdiction.

In Canada, standards and codes are adopted and enforced by both federally and provincially designated agencies through regulations made under a variety of legislative acts. The federal government, through Transport Canada, has the authority for new vehicles, but modified vehicles and fuelling facilities are primarily a provincial responsibility.

The Canadian Standards Association (CSA), which is accredited by the Standards Council of Canada (SCC), publishes most of the Canadian NGV codes and standards that are recognized by regulations. However, a significant number of either international or foreign standards are referenced either by regulation or through a document published by the CSA. An overview of the Canadian NGV regulatory system is given in Figure 1.

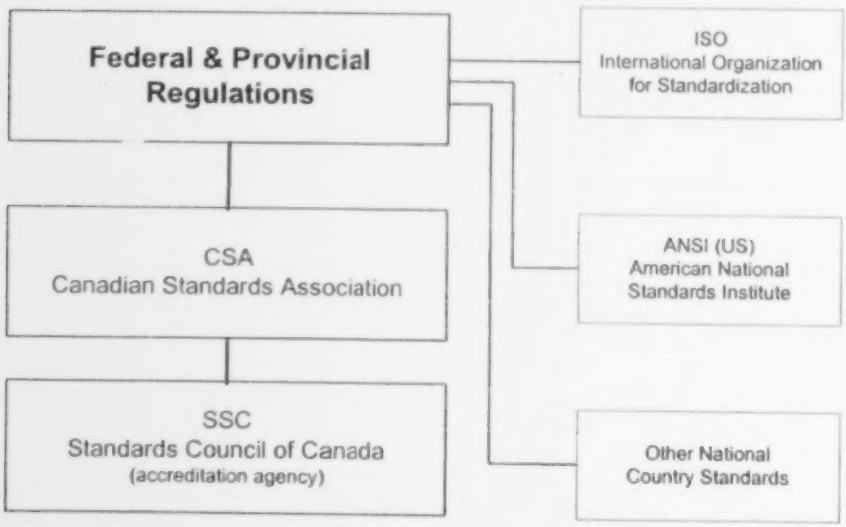

Figure 1 - The Canadian NGV Regulatory System

Most of the NGV standards and codes have been consolidated under the CSA. A simplified outline of the standards development process is shown in Figure 2. The majority of the technical work is undertaken by standing sub-committees or by specialized working groups. For clarity the feedback loops addressing comments from the public or CSA internal reviews and the InterProvincial Gas Advisory Council are not shown. These are dealt with at either the main NGV Committee or sub-committee level.

Documents are normally revised or re-affirmed at five-year intervals under SCC guidelines.

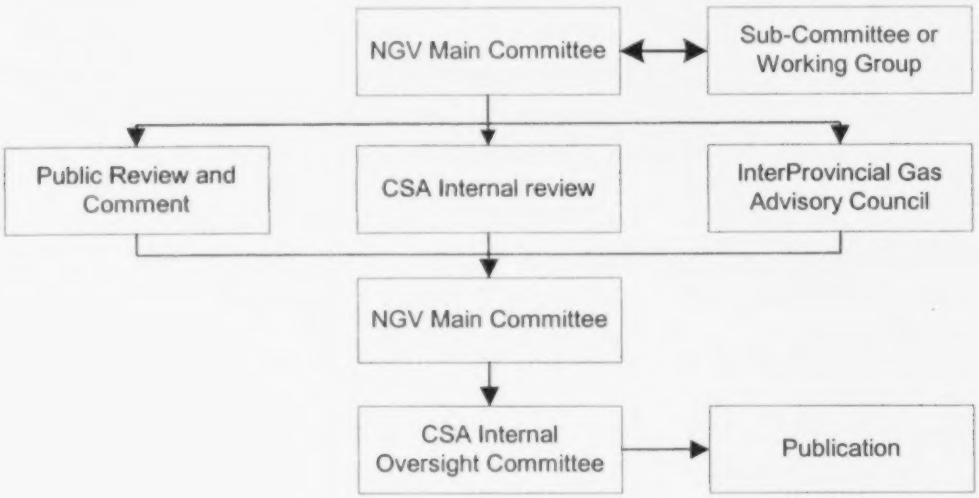

Figure 2 - The Canadian NGV Standards Process

CCi and/or PLI personnel were fully accredited in all the major NGV committees and working groups that were relevant to this work as shown in Table 1.

Table 1 Committee and Working Group Membership

Committee or Working Group that is Active on the Standard or Code	CCi Participation Level	PLI Participation Level
CSA 12.x NGV standards: Joint Canadian and US standards for fuelling facility components and sub-systems.	Member of all	Member B12.3
CSA B51 Part 2 and Part 3 Sub-committee: High-pressure cylinders for the onboard storage of natural gas as a fuel for automotive vehicles, and requirements for CNG refuelling station pressure piping systems and ground storage.	Member	Secretary
CSA B108 & B109 Committees: Canadian installation codes for natural gas vehicle and fuelling facilities.	Member	
CSA B339 & B340 Committees: Cylinders, spheres, and tubes for the transportation of dangerous goods, and selection and use of cylinders, spheres, tubes, and other containers for the transportation of dangerous goods, class 2.	Member	Member

Committee or Working Group that is Active on the Standard or Code	CCi Participation Level	PLI Participation Level
CSA NGV Strategic Steering Committee: Canadian national and Canadian harmonized (joint Canada/US) safety standards relating to all natural gas vehicle technologies and fuelling facilities.	Chair	Member
SCC 504 Canadian ISO Liaison Committee: Reviews ISO documents relating to road vehicles using natural gas and makes recommendations regarding Canada's acceptance of those documents.	Chair	Member
ISO TC 22/SC 25 Working Groups 1, 2 & 3: Compressed natural gas refuelling connector; Design principles and installation of vehicle fuel systems, and NGV fuel system components.	Member	Member
ISO TC 58/SC 3 Working Group 7: Compatibility of storage systems with hydrogen.	Member	Member
ISO TC 58/SC 3 Working Group 11: Over-wrapped cylinders.		Member
ISO TC 58/SC 3 Working Group 17: Compressed natural gas cylinders for road vehicles.		Convener
ISO TC 58/SC 4 Working Groups 2 & 3: Retesting of cylinders by acoustic emissions, and methods for inspection and requalification of NGV fuel gas containers.		Member
NGV 1 Working Group: NGV fuelling connectors.	Member	
NGV 2 Working Group: Design and use of storage containers for natural gas powered vehicles.	Chair	Member
PRD1 Working Group: Pressure relief devices for gas storage cylinders.	Member	Member

4. Work Performed

During the course of the project, monthly reports were submitted to the sponsoring members to describe the meetings attended by the contractors, the work performed, and the major issues regarding NGV codes, standards and safety. The following sections summarize the information from the monthly reports about meetings attended and documents published.

4.1 Meetings

Meetings of standards committees, working groups and regulatory agencies were attended as shown in Table 2.

Table 2 Meetings Attended

	Date	Topic	Location / Venue
2001 (previous reporting period)	19 Mar	CSA B339/B340 Committees	Toronto
	22 Mar	Ontario Technical Safety Standards Authority (new Act)	Rexdale
	9 Apr	Ontario Technical Safety Standards Authority (new Act)	Rexdale
	18 Apr	Ontario Technical Safety Standards Authority (new Act)	Rexdale
	13 Jun	CSA B108	Rexdale
	14 Jun	CSA B12.6	Rexdale
	26 Jun	PRD1	Cleveland
	28 Jun	CSA B12.3	Cleveland
	Jul	CSA B51 Parts 2 & 3 Sub-committees	Teleconference
	20 Aug	NGV R&D Committee	Toronto
	30 Aug	NRCan meetings	Ottawa
	6-7 Sep	Fuel Cell Alliance Working Meeting	Winnipeg
	29-30 Oct	CSA B339/B340	Rexdale
	9 Nov	CSA B108	Rexdale
	7 Dec	Standards Council of Canada Committee Chairs	Rexdale
2002	25-26 Jan	Meetings with Powertech Labs	Vancouver
	11 Feb	NGV R&D Committee	Teleconference
	22-23 Apr	CSA B108; CSA B12.6; Interim Standards Steering Committee	Teleconference
	28-30 May	CSA B339/B340	Rexdale
	12-13 Jun	NGV R&D Committee/MDIP	Ottawa
	22 Aug	B339/B340	Vancouver
	6 Sep	Ontario TSSA Compressed Natural Gas committee	Rexdale
	25 Sep	NRCan NGV R&D Committee	Teleconference
	26 Sep	Ontario TSSA annual general meeting	Rexdale
	26 Sep	Ontario TSSA Compressed Natural Gas committee	Rexdale
	Oct	IANGV meetings and biannual conference; IANGV Technical Committee	Washington

	Date	Topic	Location / Venue
	21-23 Oct	CSA B339/B340 Committee and Transport Canada Symposium on PRDs	Ottawa
	18 Nov	Joint meeting of NRCan NGV R&D Committee and MDIP's Advisory Committee	Ottawa
	29 Nov	Meetings with Powertech Labs	Vancouver
2003	28-29 Jan	NGV Technology Forum Technical Committee	Dallas
	27 Jan	Met with CSA staff re CSA 12.6	Mississauga
	6 Mar	CSA 12.6	Voice & internet
	17 Apr	NGV R&D Committee	Teleconference
	6-7 May	PRD1 & NGV3 Meetings	Cleveland
	26 May	TSSA Risk Reduction Group	Toronto / TSSA
	3 Jun	NGV R&D Committee	Ottawa
	17 Jul	B51 Sub-Committee	Toronto / CSA
	24 Jul	NGV1 Technical Advisory Group	Cleveland
	13 Aug	CSA meeting re publication of standards	Toronto / CSA
	26 Aug	NGV3	Cleveland
	9-10 Sep	NGVTF meetings	Albany
	17 Sep	Meeting at TSSA re Faber cylinder failure	Toronto / CSA

Official minutes of the meetings that were attended are available to bona fide interested parties from the organization that provides secretariat services to the group. These may include detailed information in the case of government-sponsored meetings or, in the case of standards development groups, this may be only the information that directly pertains to the development of that standard.

4.2 New Publications

The standards shown in Table 3 relevant to the NGV industry were published during the period covered by this report.

Table 3 Published Documents

Publication Date	Title
2001	ANSI/CSA NGV2a Addenda 1 to ANSI/CSA NGV2-2000, Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers
2002	CAN/CSA-B339 Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods
2002	CAN/CSA-B340 Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2
2002	ANSI NGV 4.8/CSA 12.8 Natural Gas Fueling Station Reciprocating Compressor Guidelines

Publication Date	Title
2003	B51-03 Boiler, Pressure Vessel, and Pressure Piping Code

4.3 NGV Codes and Standards

The work done on the various codes and standards throughout the reporting period is summarized below, by document. Some information on work undertaken before this reporting period is included for the sake of continuity.

4.3.1 CSA-B108 Natural Gas Fuelling Stations Installation Code

The current edition of the B108 Code was published in 1999. It was under review through 2001-2002. While the new edition was originally planned for publication in late 2002 or early 2003, this has been delayed and it is now not expected until late 2004.

Time was spent in 2002 working with the B108 Committee to develop coverage in two new areas. A draft revision for Section 5 allowing for partial system shut-downs was prepared, and additional work was done to assist in the development of maintenance requirements to be included in the Code.

Ontario's Technical Standards & Safety Authority (TSSA) had requested that the station general maintenance requirements adopted by Ontario in 2001 be considered for inclusion in the next edition. Indoor fuelling maintenance requirements were approved as part of the indoor fuelling annex in 2000.

Since the last publication of the Code in 1999, several important changes were issued as annexes, including the new indoor fuelling requirements and the emergency shut-down device system modifications. The project participants assisted in incorporating these into the main body of the updated document. The clause order was revised in the document to group clauses by subject area.

In April 2002, a report was put to the B108 Committee noting electrical classification discrepancies between the current B108-1999 and the Canadian Electrical Code (CEC)-2002 documents. In discussion of these discrepancies, it was considered possible that a hazardous situation could arise. A working group was established to work with the CEC Section 20 Sub-Committee to resolve this issue.

Time was spent working on the discrepancies between the B108-1999 and the CEC-2002 codes. After review of both codes, the Working Group proposed a joint recommendation to the Gas and Electrical Committees that would harmonize the requirements and make the coverage consistent with electrical treatment of other fuels. This proposal would require three changes to the CEC and one change to B108.

The changes were sent to the respective committees for consideration. If accepted, the proposals will be circulated by CSA for public review and comment.

Both Nick White and Craig Webster reviewed draft versions, and the B108 Committee and the NGV Standards Steering Committee approved the new edition in June 2002. The electrical classification discrepancies are still unresolved at the time of writing this report.

4.3.2 CSA B109 Natural Gas for Vehicles Installation Code

In 1999 the CSA B109 Code was issued as a separate document replacing CAN/CGA B149.4. No issues were raised concerning this code during the reporting period.

4.3.3 CGA 12.3 Fuel System Components for Natural Gas Powered Vehicles

This document was published in 1995, and is currently under review. It was published in the United States as ANSI/AGA NGV 3.1.

The first meeting of the harmonized CGA12.3/NGV3.1 Fuel System Components for Natural Gas Powered Vehicles Working Group since the document was published was held in June 2001. From discussions at the meeting it was apparent that the document is widely used in both the original equipment manufacturer (OEM) and conversion industries. Most OEMs have additional performance requirements in addition to the safety requirements contained in the document. In the following months the Working Group addressed three major items that arose from the meeting:

- Lowering the allowable leakage rates for individual components to ensure vehicle assemblers can reach the target for total vehicle leakage using certified components.
- Revising and clarifying some of the test procedures to ensure that they are reproducible at all test facilities.
- Reformatting the document to mirror the format used in ISO 15500 Road vehicles – Compressed Natural Gas (CNG) Fuel System Components and ensuring that there were no gaps in coverage. ISO 15500 is organized into nineteen chapters that address different components. Given the international nature of the NGV industry, manufacturers felt that using the same format could assist in making products more widely available by simplifying the certification process.

This committee has held two additional meetings, but a date has not been set for publication of the revised standard.

4.3.4 CSA 12.5 NGV Dispensing Systems

Published in the United States as ANSI/IAS NGV 4.1. No work was required during the reporting period. Work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the United States Department of Energy (US DoE).

4.3.5 CSA 12.52 Hoses for Natural Gas Vehicles and Dispensing Systems

Published in the United States as ANSI/IAS NGV 4.2. No work was required during the reporting period. Work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.6 CSA 12.53 Temperature Compensation Devices for Natural Gas Dispensing Systems

Proposed to be published in the United States as ANSI/NGVC NGV 4.3. The NGV Standards Steering Committee was advised in June 2002 by CSA that CSA was no longer working on developing this standard. This may be revised as work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.7 CSA 12.54 Breakaway Devices for Natural Gas Dispensing Hoses and Systems

Published in the United States as ANSI/IAS NGV 4.4. No work was required on this standard during the reporting period. Work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.8 CSA 12.55 Priority and Sequencing for Natural Gas Dispensing Systems

Proposed to be published in the United States as ANSI/NGVC NGV 4.5. The NGV Standards Steering Committee was advised in June 2002 by CSA that CSA was no longer working on developing this standard.

4.3.9 CSA 12.56 Manually Operated Valves for Natural Gas Dispensing Systems

Published in the United States as ANSI/IAS NGV 4.6. No work was required on this standard during the reporting period. Work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.10 CSA 12.57 Automatic Pressure Operated Valves for Natural Gas Dispensing Systems

Proposed to be published in the United States as ANSI/NGVC NGV 4.7. The NGV Standards Steering Committee was advised in June 2002 by CSA that CSA was no longer working on developing this standard. Work is planned on a

revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.11 CSA 12.6 Vehicle Refuelling Appliances

This document, published in 1994 as a CGA standard, was under review in 2001-2002, with a new edition expected in 2003. It is similar to AGA Requirement 2-90 in the United States.

A major task in drafting the new version was to harmonize the document with the NGV standards published since that time. The major items were the harmonization of the pressures with the B108 and CSA 12.5x series of standards. (The current CSA 12.6 is a 1994 edition and was published before the current pressure-temperature numbers were finalized and adopted.)

The new draft also contains language that recognizes that vehicle refuelling appliances (VRAs) may be connected to storage or piping systems. Documents were submitted to the B149.1 committee to bring the VRA segment up to date. The draft document was sent to the full B12.6 committee in July 2001 for approval before it went on to the NGV Standard Steering Committee.

In 2002 there was a proposal to include a set of requirements that would allow VRAs to be certified for indoor installation. This was accepted in principle and a working group was established under FuelMaker Corporation to develop a detailed proposal for consideration by the CSA 12.6 Committee.

The project participants also reviewed changes to the proposed 2002 edition regarding its compatibility with the B51 Boiler, Pressure Vessel, and Pressure Piping Code and B108 Natural Gas Fuelling Stations Installations Code documents.

The revised CSA 12.6 Standard was reviewed and accepted by the Committee in April 2002 but had not been published at the time this report was written.

4.3.12 CGA 12.8 Natural Gas Vehicle Fueling Station Compressor Guidelines

A proposed document was approved for publication in 2002 and published in the United States as ANSI/ NGVC NGV 4.8. Work is planned on a revised edition to address hydrogen fuel in 2004 under the sponsorship of the US DoE.

4.3.13 CAN/CGA B149.1 Natural Gas and Propane Installation Code

A review was performed of Part 9 on the installation of Vehicle Refuelling Appliances Without Storage.

4.3.14 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code

This includes Part 2 "High Pressure Cylinders for the On-Board Storage of Natural Gas as a Fuel for Automotive Vehicles" and Part 3 "Requirements for CNG Refueling Systems and Ground Storage Vessels".

The project participants worked to ensure publication of the new edition of the CSA B51 standard. This took place in January 2002.

The B51 Part 2 and Part 3 Sub-Committee met in July 2001 in Edmonton, with members from eastern Canada attending by teleconference. This meeting was of particular importance because it focussed on changes to be considered at the B51 Main Committee in the autumn. Although the B51 Part 2 and Part 3 Sub-Committee has met several times since the last publication of B51, none of the proposed amendments have been formally submitted to the B51 secretariat.

Major technical issues that were approved were the environmental test (for automotive fluids) and the inclusion of the steel requalification procedure as an annex to Part 2. The correlation between test cycles and years of service remains an unresolved issue between B51, NGV2 and ISO 11489.

The only serious NGV incident in Canada occurred at the conclusion of the work contract. It involved the failure of a fuel tank approved for use under a previous edition of B51. Investigations indicated that unusual service conditions, together with improper maintenance, were the reasons that the problem was not detected and corrected before the failure occurred.

Figure 3 - A Vehicle after Fuel Tank Failure

4.3.15 CAN/CSA B339 Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods

See CAN/CSA B340 in Section 4.3.16.

4.3.16 CAN/CSA B340 Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2

The current versions of B339 (1996) and B340 (1997) were under review during the project, with new editions published in 2003. These documents are discussed jointly because the committees usually meet together.

The main NGV issues before these committees were the proposal to enable aluminium cylinders to be filled with natural gas and development of suitable language to allow the use of carbon fibre wrapped cylinders for transportation purposes. For the latter topic, a Carbon Fibre Working Group was established.

Although the issue of carbon fibre wrapped cylinders is common to all gases, the particular interest is from Dynetek, Luxfer, and Pressed Steel Tanks, which would

like their carbon wrapped cylinders to be available for use in either natural gas ground storage or transportation applications. Since ISO 11119-1 and ISO 11119-2 had been approved, and ISO 11119-3 was currently being balloted, it was proposed that Canada recognize cylinders made to these standards as acceptable for use.

The main committee accepted that it was safe to use aluminium cylinders for the transportation of natural gas but rejected the ISO performance tests and instead mandated the use of 6061 alloys. This is not an immediate issue as all cylinders currently marketed use this alloy. The recommendation includes all-metal and wrapped cylinders. Small cylinders that have no life limit will be required to be visually inspected every five years.

There were no objections to the use of natural gas in aluminium cylinders raised in the review and comment period so that proposal was incorporated as part of the B340-2003 edition. Although this was agreed in principle, Transport Canada asked that this recommendation be deferred until after the UN conference on transportation cylinders was held in July 2002, when the position of other countries with regard to this subject would be known.

4.3.17 CGA NGV1 Compressed Natural Gas Vehicle (NGV) Fueling Connection Devices

This document was published in 1994 and an addendum was published in 1997. Although there has been discussion of expanding its scope to cover high capacity nozzles, no work has started on this topic. The standard is published in the United States as ANSI/AGA NGV1.

A new issue surfaced in 2003 concerning rapid wear on fuel connectors that are filled using ball lock style nozzles and the new "full fill" computerized dispenser technology. As shown in Figure 4, excessive wear has been detected, which results in difficulties during connecting and disconnecting. No incidents resulting in injury have been reported and the worn components can be replaced, but there is a safety concern due to the possibility of operators using excessive force to either hammer connectors on or remove them after filling.

This subject was still under investigation at the conclusion of this work.

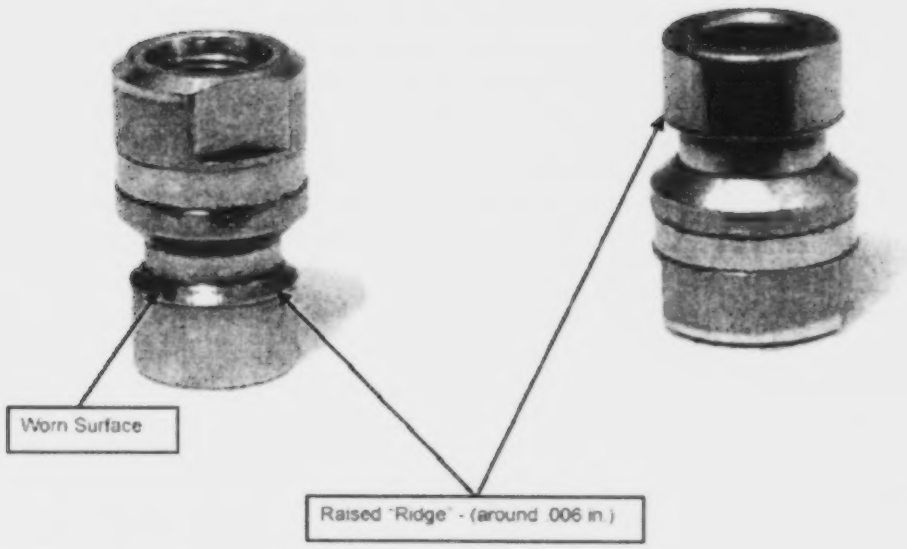

Figure 4 - Wear on Fuelling Connectors[1]

4.3.18 ANSI/IAS PRD 1 Pressure Relief Devices for Natural Gas Vehicle (NGV) Fuel Containers

The 1998 edition, with a 1999 addendum, is currently under review. A new edition is expected in 2004.

The PRD1 Committee met in Cleveland in June 2001 as a follow-up to the Lincoln review meeting held the previous summer. There continues to be strong interest in further development of this standard, as was shown by the high attendance at the meeting and the 121 page agenda. Although PRD1 is a new standard, produced originally for the US and Canada, it is rapidly gaining recognition around the world as the authoritative PRD document. The project proponents worked at "tweaking" a few of the test procedures and ensuring that the standard fits smoothly with the B109 Natural Gas for Vehicles Installation Code and NFPA52 Standard on Compressed Natural Gas (CNG) Vehicular Fuel Systems.

It is now anticipated that the new edition will also address hydrogen fuel under the sponsorship of the US DoE.

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[1] Photograph supplied by manufacturer to the CSA NG1 Technical Sub-committee

4.4 Regulatory Liaison

Several meetings were held with the Ontario Technical Standards & Safety Authority. TSSA staff agreed to recommend that the maintenance provisions for NGV fuelling facilities recommended by the NGV industry be adopted into the code in the new Ontario Act. Less pleasing was their decision (made at a meeting to which the NGV industry was not invited) not to include the parallel changes that had been requested in the Operating Engineers section of the Act.

TSSA will be requesting that the station general maintenance requirements adopted by Ontario in 2001 be considered for inclusion in the 2002 edition of B108. The indoor fuelling maintenance requirements were approved as part of the indoor fuelling annex in 2000 and have already been included.

Other regulatory liaison work included reviewing and providing comments on the proposed Ontario Gas Safety Code Adoption Regulation, and attending meetings with Natural Resources Canada to discuss the logistics of the NGV codes, standards and safety work in Canada

4.5 NGV Standards Steering Committee

The integration of the NGV standards into the CSA procedures continued during the reporting period. In 2002 CSA performed a review and indicated that it considered that the CSA committees should replace the CGA/IAS committees as shown in Table 4.

Table 4 Replacement Committees

CGA/IAS Committee Terminology	CSA Committee Terminology
NGV Standards Steering Committee (balanced)	NGV Technical Committee (balanced)
NGV B108 and B109 Code Committees (balanced)	NGV Technical Sub-Committees (not necessarily balanced)
NGV Standards Committees and Working Groups (not balanced)	NGV Technical Advisory Groups (not balanced)

This ad hoc system involved an increased number of ballots and reviews and has been one of the causes of delays in getting standards published. On some documents there have been up to four ballot levels and, if a change is requested by the Inter-Provincial Gas Advisory Council, revisiting the issue has taken up to eight months compared to the normal six weeks.

Following up from discussions in 2002, CSA sent suggestions on approaches to re-organising the NGV (Canadian and harmonized) committees to the chair of the Interim CSA Steering Committee on Natural Gas Powered Vehicle and Fuelling. The current NGV committee structure still reflects the history as part of

the CGA/IAS system as it has not yet been fully integrated into the normal CSA approval system.

A suggested structure based on the current mandates of the NGV committees aimed at reducing and simplifying the work of each committee was prepared and sent to CSA for its consideration.

In all the standards areas, the availability of funds and persons to work on committees has been reduced in the past few years and the byword at CSA is consolidation. With the splitting off of CSA (Canadian Standards Association dealing with standards only) from the rest of CSA International, it is anticipated that there will be increasing cost pressures in 2002 and beyond.

At the June 2002 meeting, the Committee formally approved a new scope and membership that would lead to the integration of the Committee as a balanced Technical Committee under the CSA Strategic Steering Committee on Gas Industry. The only item where there was discussion was the proposal that committees could, if requested, consider hydrogen as well as natural gas. One member abstained from the vote on this issue, as his company had neither interests nor expertise in this area. A copy of the approved document was provided to the Transportation Development Centre.

The Committee approved by recorded vote the proposed new editions of the B108 and CSA 12.6.

4.6 ISO Standards

The following documents were reviewed and recommendations were made to SCC regarding Canada's approval of their becoming international standards that could be recognized by Canadian agencies.

ISO 11119 *Gas cylinders of composite construction — Specification and test* methods.

ISO/DIS 11439 *Gas cylinders -- High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles.*

ISO 15500 *Road vehicles -- Compressed natural gas (CNG) fuel system components. (Parts 1 – 19).*

ISO/DIS 15501 *Road Vehicles -- Compressed natural gas fuelling systems.*

ISO/WD 19078 *Gas cylinders -- Inspection for requalification of high pressure cylinders and their installations, for the on-board storage of natural gas as a fuel for automotive vehicles.*

ISO 14469 *CNG Fuelling Connectors Road Vehicles -- Compressed natural gas (CNG) refuelling connector.*

ISO 15403 *Natural gas -- Designation of the quality of natural gas for use as a compressed fuel for vehicles.*

4.7 NRCan Support

CCi provided secretariat support for the NGV R&D Committee established to oversee the expenditure of funds transferred from GRI Canada to NRCan. This secretariat work included:

- Arranging Committee meetings.
- Preparing and obtaining background materials for Committee meetings.
- Attending Committee meetings, taking minutes, and distributing minutes to Committee members.
- Preparing reports and making presentations to the Committee as requested or required.
- Attending other meetings and presenting positions and proposals as requested or required on behalf of the Committee.

CCi also attended other meetings and presented positions and proposals as requested or required on behalf of the Committee. The NRCan NGV R&D Committee met for the first time on the 20th of August and CCi has provided secretariat services to the Committee on an as-needed basis.

These activities were discontinued with the transfer of Funds from NRCan to the newly established Advanced Transportation Fuels Canada in 2003.

4.8 P36 Pressure Standard

The project participants reviewed responses to the Ontario request to assess safety issues regarding the use of the P36 system in Canada and contacted committee chairs regarding required changes to Canadian codes or standards.

An editorial working group had proposed a number of corrections and clarifications to the B108 document and these were adopted. In addition, a proposal to explicitly recognize the P36 system and include the various maintenance requirements was put forward. The proposal was accepted and the amended document was sent to the NGV Steering Committee.

5. Conclusions

This report concludes a long-term joint government-industry campaign to address safety incidents and develop and publish NGV standards and codes. The success of this campaign can be seen in the low number of incidents and the adoption and use of the Canadian work both in international and foreign standards.

Although the development of NGV standards has reached a mature stage, there are issues that will need to be addressed in the future. For example, the component standard is outdated and does not reflect a number of new technologies. It will need a comprehensive review and expansion to include new technology and up-to-date test procedures.

Maintenance of standards is an issue as new technology is introduced. One emerging problem has been the rapid wear on fuel connectors that are filled using ball lock style nozzles and the new "full fill" computerized dispenser technology. Excessive wear has been detected, which results in difficulties during connecting and disconnecting. Although no incidents resulting in injury have been reported and the worn components can be replaced, the safety concern is the possibility of operators using excessive force to either hammer connectors on or remove them after filling.

A comprehensive review and modernization of the station installation code has been completed but has not been published by the CSA. With the adsorption of International Approval Services (itself an amalgamation of the Canadian Gas Association's and American Gas Association's standards groups) and the cessation of funding for natural gas standards by the distribution utilities monies for the revision and publication of new and updated standards has become a serious issue.

However, the US DoE has made funds available for the development of hydrogen vehicle standards to mirror those developed for NGV, and much of the information that will result from this work is likely to be directly applicable to compressed natural gas.

The value of the work that has been undertaken in Canada is evident in two areas. First, the methodology and approach taken in the Canadian and joint Canadian/US documents have been adopted widely both in ISO and other countries. Second, the documents produced for natural gas are well suited for use with other gaseous fuels and have, in many cases, formed a starting point for work on hydrogen-fuelled vehicles.